BACCALAURÉAT - Session 2015

Epreuve de Discipline Non Linguistique

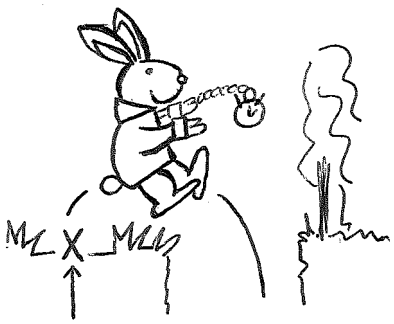
Mathématiques/Anglais

Alice ran after a rabbit with a watch

Alice ran after a rabbit with a watch [...] and fortunately was just in time to see it pop down a large rabbit-hole under the hedge.
In another moment down went Alice after it [...].
The rabbit-hole went straight on like a tunnel for some way, and then dipped suddenly down, so suddenly that Alice had not a moment to think about stopping herself before she found herself falling down a very deep well.
[...] Down, down, down. Would the fall never come to an end! 'I wonder how many miles I've fallen by this time?' she said aloud. 'I must be getting somewhere near the centre of the earth. Let me see : that would be four thousand miles down, I think—' [...] 'I wonder if I shall fall right through the earth! How funny it'll seem to come out among the people that walk with their heads downward!

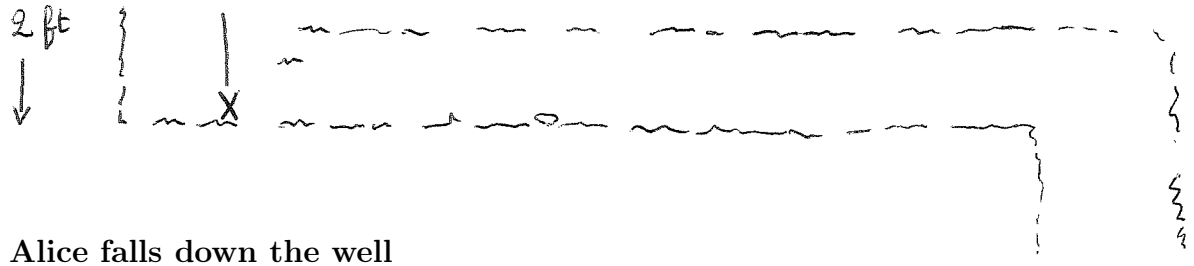
Alice's Adventures in Wonderland, 1865, by Lewis Carroll.

1.a. Make a short presentation of the text.
1.b. Give the radius of the Earth R_{Earth} in miles.
Do you know how many kilometers it is?

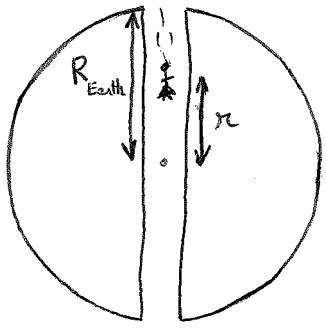


2. The Rabbit pops down a large rabbit-hole
Let's say that the altitude of this strange Rabbit during its spring[1] (in feet) is given by the function f : $f(t) = -t^2 + 0.5t + 2$ for $t \in [0; 10]$ (t is the time in second).
2.a. What kind of function is f?
2.b. At time $t = 0$, the Rabbit starts its spring at 2 feet high.
So $f(0) = 2$.
When will it land on the ground of the rabbit-hole (at 0 foot high)?

1 : un saut



3. Alice falls down the well
Near the surface of the Earth, the gravity of Earth is equal to $g = 9.8\ m/s^2$.
But as Alice is falling deep down, we consider that the gravity (in m/s^2) is equal to $h(r) = g\dfrac{r}{R_{Earth}} = 1.5 \times 10^{-6} \times r$
where r is the distance between Alice and the center of the Earth (in meters).
3.a. What kind of function is h?
3.b. Sketch the graph of the function h for $r \in [0; 6.4 \times 10^6]$.



4. Assuming the Earth to be of uniform density and neglecting air friction and high temperature of her trip, Alice would pop up on the opposite side of the Earth after a little more than 42 minutes... What an amazing trip, don't you think?